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Abstract from Archive Phys. Med. 29 402 July (1948)

PROGRESS IN USE OF ULTRAVIOLET RADIATIONS*

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The production of ultraviolet erythema results from a chemical reaction by ultraviolet radiations on protein in the malpighian layer of the epidermis. One of the substances formed appears to be leukotaxine which causes edema, swelling and migration of leukocytes. Still another substance, which has not been isolated, exerts a dilating action which produces the erythema.

Ultraviolet erythema produces what is known as a counterirritation. The biologic effects of counterirritation are well recognized as a means for the production of local effects such as dilation of blood vessels and sensation of warmth and mild anesthesia. More general effects may be a rise in blood pressure and accentuation of heart beat and respiration.

Ultraviolet applications have been used frequently for the production of counterirritation effects. Recently, D. A. Jesse at the Physical Therapy Institute of Rotterdam, Netherlands, has advocated application of this therapy for the treatment of arthritis, neuralgia, neuritis and bursitis. He claims that his method of application is different from that previously employed and that for this reason his results are more satisfactory than have been previously reported.

He says that in the past two mistakes have, in general, been made: 1. The skin area irradiated was too large. 2. The degree of erythema produced was not accurately controlled. According to his experiences, when the skin area is too large the patient does not obtain the maximum degree of benefit because the counter-reaction is not sufficiently localized. He prefers to irradiate an area 5 by 8 cm. on an arm or shoulder

and 12 by 15 cm. if a leg. Only one area is irradiated at a time. He asserts that the degree of erythema employed is very important. If the erythema is too weak, favorable results are not obtained. If the erythema is too strong, so that inflammation results, the therapeutic effect will be debilitation. He recommends a definite red erythema and emphasizes that prior to the start of the treatments the conditions for the irradiation must be established. It is well known that skin areas on the same patient vary greatly in their response to ultraviolet radiation. A person's response itself varies from day to day, being dependent upon diet, humidity and other physical factors. Individuals differ in their response to ultraviolet radiation. Hence, it is not possible to apply a rule-of-thumb irradiation technic. Each patient must be actually tested at the time just prior to treatment for erythema responses. Thus, if a treatment is to be applied to a right shoulder, the correct dosage of ultraviolet rays must be established by the irradiation of small test areas on the left shoulder. The day following the test exposure the correct degree of erythema may be selected, and the exposure conditions employed to produce this erythema may then be employed for the actual treatments. The correct degree of erythema is definitely red but not uncomfortable to touch. Dr. Jesse found that the most satisfactory erythemas were produced by the hot quartz mercury arc lamp.

He claims for results, first, an analgesic effect—the patient feels less acute pain, moves the part more easily and sleeps better—and, second, a therapeutic effect—circulation improves, and muscular control is better. He maintains that his method produces

results which compare favorably with results obtained by the employment of other physical agents but that he obtains his results by means of the ultraviolet erythema more quickly.

In a photosensitization process, the radiation which causes the reaction does not act directly upon the actual reactants but, instead, acts upon some substance which is capable of passing along the energy of the radiation, or a sufficient portion of it, to the actual reactants. The existence of photosensitization was recognized in 1900, but it was Klein and Rosseland in Germany in 1921 who first clearly defined the phenomenon. A large number of substances have been observed to be photosensitive. Some have been successfully employed in processes for the manufacture of commercially useful products, such as insecticides, waterproofing materials and chewing gum.

It had been observed that crude coal tar could sensitize the skin to ultraviolet radiations and that it was generally characteristic of skin sensitizers that they must reach the malpighian layer of the epidermis to be effective. About twenty years ago dermatologists began to treat psoriasis by application of coal tar sensitizer and ultraviolet rays. In 1941 a group of leading dermatologists reported very favorably upon the results obtained by such treatments, and, in fact, indicated that ultraviolet and photosensitization were the preferred method for the treatment of psoriasis.

Recently Ervin Epstein, of Oakland, Calif., has reported an additional means for sensitizing the psoriasis reaction. He appears to have combined with the external photosensitization a means of internally photosensitizing the reaction. He has done this by administering to the patient orally four doses of 5 grains each of sulfanilamide on the day prior to the ultraviolet irradiation.

In order to establish the effectiveness of his procedure, he divided patients, 58 in

all, into five groups. These groups were treated by the following means. (1) roentgen rays; (2) ultraviolet rays produced by the hot quartz mercury vapor arc lamp; (3) ultraviolet rays plus crude coal tar; (4) ultraviolet rays plus sulfanilamide; (5) ultraviolet rays plus crude coal tar and sulfanilamide. Sulfanilamide alone had been found to be ineffective for the control of psoriasis.

Epstein has reported that the ultraviolet photosensitized coal tar treatment appears equally as effective as roentgen treatment for the control of psoriasis and recommends it as a safe substitute for roentgen ray treatments when the latter therapy is not applicable. He found that ultraviolet irradiation alone was comparatively ineffective, which is in agreement with generally accepted opinion. The administration of sulfanilamide orally prior to the irradiation by ultraviolet greatly accelerated the average improvement, and confirmed an earlier observation by I. Tulipan that sulfanilamide could photosensitize the ultraviolet treatment of psoriasis. When combined with coal tar photosensitization, the average number of required treatments was reduced to between one-third and one-half those customarily required when either roentgen ray or ultraviolet photosensitized coal tar treatments were employed.

Further evidence that sulfanilamide may act as a photosensitizer has been provided by Harold Blum, who has studied its action on the enhancement of ultraviolet skin erythema. When a solution of sulfanilamide was injected intradermally just prior to an ultraviolet irradiation, the skin area at the site of the injection developed a more marked erythema than did the surrounding areas. When the injection of the sulfanilamide was delayed until immediately after the ultraviolet irradiation, there was observed no added effect. Blum considered that this indicated that the action of the sulfanilamide was associated with

the ultraviolet rays rather than directly on the response of the blood vessels of the skin. The action spectrum for the sulfanilamide appeared to be similar to that for normal ultraviolet erythema production, since there was no observable erythema, even with sulfanilamide injections, if the ultraviolet rays were filtered through a glass which removed the portion of the spectrum normally effective in erythema production.

The sulfanilamide reaction is not an isolated example of photosensitization. Many drugs and dyestuffs are known to behave as photosensitizers but have not been tried in controlled experiments to establish whether they possess value as therapeutic agents. Without controls, it is always possible to attribute results to some other factors. Further investigation of photosensitization in therapeutics appears to be warranted.

Ultraviolet fluorescence results when radiation displaces electrons in phosphors, which are substances having elastic electrons. The ultraviolet radiation pulls electrons out of their normal orbits. When these electrons spring back, light visible to the eye is produced.

The practical observance of fluorescence was made possible by Prof. R. W. Wood in 1903 by the construction of filters which transmitted the ultraviolet rays but excluded visible light. The exclusion of visible light permitted fluorescence at low intensities to be observed and studied. Ultraviolet fluorescence is very familiar today, especially in the form known as the fluorescent lamp, in which the exciting ultraviolet rays and the fluorescence are generated with the same tube, and the fluorescence is used for illumination.

Many substances fluoresce when exposed to ultraviolet rays. Because of this and differences in the color of the fluorescent light, it is frequently possible to use fluor-

escence to distinguish between substances which otherwise can be differentiated only by laborious analyses. Fluorescence is used in industry for control of quality of materials. It has come to render valuable assistance in medical diagnosis.

Fluorescence as a diagnostic aid has been indispensable during the recent epidemic of tinea capitis, ringworm of the scalp, which has infected children in some parts of the United States. The fungus of this infection appears as a brilliant greenish yellow fluorescence when viewed by filtered ultraviolet rays from the hot quartz mercury vapor arc lamp. The fluorescence is very characteristic and cannot be confused with the fluorescence of any other fungus or disease of the scalp. By means of fluorescence the presence of the fungus may be observed several days before any other manifestation of the infection may be detected. It has proved a highly reliable tool for screening quickly all children in epidemic areas, isolating those with infection and controlling the spread of the disease.

The possibility that fluorescence may be employed for the differentiation of normal from malignant tissues was reported many years ago. During the war Louis Herly was at the Cancer Institute, Bethesda, Md., and reported that differences in the appearance of benign and malignant tumors of the breast were sufficient when viewed by fluorescence to enable him to make a diagnosis. He made a diagnosis in 200 cases of suspected breast cancer. A laboratory check found that he was in error in only one observation.

Dr. Herly is now at Columbia University, where he has continued his investigations of fluorescence as a means for cancer detection. He reported to the International Cancer Congress recently assembled at St. Louis that blood serum from normal animals viewed by filtered ultraviolet appeared turbid and fluorescent, whereas the blood

from cancerous subjects was clear and failed to glow. Herly said that cancer produced by injection of carcinogens into animals may be detected after only twenty to forty hours by fluorescence, whereas by other means five or more days are required for detection. The test has not as yet been applied to human subjects.

Prof. George Moore, University of Minnesota, has just reported briefly in a note to *Science* that malignant tumors of the brain may be reliably recognized by fluorescence if prior to the inspection the patients have been given an intravenous injection of 5 cc. of a 20 per cent solution of sodium fluorescein. The dyestuff appears to concentrate in the tumors if they are malignant but does not concentrate in benign tumors. When tumors contain sufficient dyestuff they fluoresce with a vivid yellow color when irradiated by filtered ultraviolet rays. The color is readily observed and unmistakable. However, if the tumors are located more than several millimeters below the surface of the brain tissue, the limited penetration of the ultraviolet rays may prevent the fluorescence from occurring.

The evidence that ultraviolet radiation can kill bacteria and viruses continues to increase. Research at the Michael Reese Research Foundation on ultraviolet irradiation of human plasma to control homologous serum jaundice have indicated that the method is a practical, yet harmless and safe, procedure which will free plasma or serum from the hazard of transmitting infectious hepatitis. Karl Habel and B. Sockrider, of the United States Public Health Service, have devised practical means for inactivating vaccines in bulk by means of ultraviolet radiations. They employed a continuously flowing thin film irradiated by ultraviolet radiations at 2537 and 1849 Å from a fused quartz sterilization lamp. The continuous flow feature and the long life of the lamp recommended their pro-

cedure for commercial production of large volumes of vaccines.

St. Luke's Hospital in New York City has reported the results of their six year study of the effects of ultraviolet air disinfection upon the incidence of respiratory infections in children. They used the percentage of children showing respiratory disease each day as the index. The indexes when plotted against time showed a marked downward trend in respiratory infections during the period when the ultraviolet tubes were used as compared with the period before the tubes were installed. It was found desirable to use the tubes both during summer months and during the winter. The investigators noted the interesting observation that there appeared to be an obvious decrease in the incidence of respiratory disease among the adult attendants, even though they did not live in the building and hence were in the sanitary air only during working hours.

Great progress is being made in the application of ultraviolet air sanitation for the preservation of foods. A considerable portion of food spoilage results from airborne bacteria and mold spores. Both of these can be killed by ultraviolet rays. Unlike chemical preservatives, the employment of ultraviolet air disinfection does not contaminate the food products with substances which if eaten regularly introduce the danger that they may contribute to some unforeseen biologic disturbance in later life. The ultraviolet method is entirely safe. The air, and not the foods, is irradiated.

Ultraviolet air sanitation may also protect foods from spoilage during failures of refrigeration. For example, meats require low temperature storage. Normally, they will spoil rapidly if kept at room temperatures. Spoilage is usually inevitable if refrigeration equipment in warehouses fails during the warm days of summer. During a recent Labor Day week end, a failure

occurred in a large Chicago warehouse. The loss of tons of meat would have resulted. In spite of temperatures of 75 F., no meat loss occurred. The warehouse was equipped with ultraviolet air sanitation. The unexpected result was attributed to this factor.

Patients and physicians may benefit from air sanitation. The Committee on Research and Standards of the American Public Health Association has recognized the value of ultraviolet air disinfection as an adjunct to aseptic technic in the reduction or elimination of air-borne bacteria in operating rooms and in contagious disease and pediatric wards, where conditions have indicated a significant incidence or risk of cross infection to patients. There are indications that air sanitation may be of value in schools, barracks and physicians' waiting and treatment rooms. However, these applications will not be officially approved until more conclusive evidence is available.

Ultraviolet blood irradiation therapy by Prof. George Miley and his associates, employing the Knott technic, is being investigated as a means for control of pyogenic infections. In this technic the patient's whole blood is irradiated and returned to the donor. The action of the ultraviolet rays upon the blood is definitely not bactericidal—that is, the destruction of the bacteria and virus in the blood does not result from the direct action of the rays upon the bacteria themselves. Some indirect

action as yet unknown must occur in the blood as a result of the irradiation. In a recent communication, Miley and Christensen have reported upon 45 consecutive and unselected cases of acute pyogenic infections and 74 cases of virus-like infections. They confirmed their original observation, published in 1942. They claim that not only sulfonamide-resistant infections have responded to this therapy but a high percentage of penicillin-resistant infections have also responded favorably. In addition, they found that toxemias due to various virus infections subside rapidly, an extremely important clinical advantage in dealing with rapidly fulminating and overwhelming infection.

It is not possible to classify this ultraviolet reaction because the mechanism is too little understood. It will probably not be understood until after the biochemists have isolated the products of the ultraviolet irradiation and physiologists have studied their behavior. Miley claims that these products provide (1) a rapid and efficient control of the bacterial infection, (2) an increase in efficiency of oxygen exchange mechanisms, (3) a detoxifying action, (4) profound effects on the autonomic nervous system and (5) a relief of asthmatic symptoms. Miley postulates that an adequate ultraviolet ray intake is of primary importance for the maintenance of normal health.

(Abstract)

SCURVY AND RICKETS ARE STILL WITH US

Editorial, Journal of American Medical Association 137 465, May (1948)

The clinical application of fundamental principles of nutrition is not abreast of the increasing knowledge of nutrition. Infants with rickets or scurvy still appear frequently in the pediatric clinics of many of

our teaching institutions. The gratitude of the teaching staffs for such teaching material is exceeded only by the embarrassment of rationalizing the occurrence of such cases to the medical student. From his

earliest days in medical school, the modern student has been taught that prophylactic administration of vitamins C and D should reduce scurvy and rickets to obsolescence.

Almost uniformly these infants have been fed on proprietary preparations which are often represented as "complete infant foods." Indeed, rapid gains in length and weight testify to the completeness of these foods, with the exception of vitamins. Because growth is occurring rapidly during

infancy, requirements for vitamins must be fully satisfied. As these preparations are usually fed under the direction of a physician, he must assume the responsibility of ascertaining the vitamin content with respect to the particular needs of the patient, regardless of what claims the manufacturer of the preparation may make. Reliance on such preparations for the vitamins is highly unwise since quantites of the product fed from day to day and from patient to patient are highly variable.

ULTRAVIOLET IRRADIATION: CLINICAL APPLICATIONS

A. P. CAWADIAS

British Journal of Physical Medicine, 12 70 (1937).

Cawadias believes that it is impossible to replace ultraviolet radiation satisfactorily with vitamin D administered by mouth because the vitamin may not be absorbed from the gastro-intestinal tract in sufficient amount to insure adequate vitamin D intake.

He states that frequently in treating rickets with ultraviolet radiation, attacks of tetany may occur because of a lowering of the blood calcium as it is removed to

the bones and inadequate calcium intake in the diet. When vitamin D is administered by mouth, tetany is less likely to occur which is suggestive that the oral application of a preparation, although supposedly in sufficient quantity, is less effective on the deposition of calcium in the bones than when the vitamin is synthesized in the skin by ultraviolet rays. If tetany occurs, the condition may be rapidly corrected by additional ultraviolet irradiation and increased calcium intake.

(Abstract)

AN EVALUATION OF HEMOIRRADIATION THERAPY

FRED B. MOORE, ROBERT E. HOYT, AND MILTON LEVINE

Arch. Physical Med. 29 358 June (1948).

The studies undertaken were designed to test, first, the possible antibacterial results of hemoirradiation and, second, the influence of hemoirradiation upon toxemia, as exemplified by botulinus poisoning.

Irradiations were made using the Knott Hemo-Irradiator and the technic employed was similar to methods described by Knott, Miley and others. The water-cooled mercury lamp was calibrated photometrically

and gave total ultraviolet 2000 to 3200 angstroms reaching chamber as 0.278 gram calories per square centimeter per second.

The direct bactericidal effect of the irradiation on the blood was determined by diluting the culture of the selected vehicle and passing it through the irradiation chamber of the Knott Hemoirradiator. Control specimens were made by closing the shutter of the irradiator while the sample passed through. The pump was set to deliver blood at a rate of 10 cc per 22 seconds. Immediately after passage through the irradiator, the control and irradiated suspensions were diluted and plated for counting. At least five agar plates were counted at each dilution.

A—Irradiation of *Escherichia Coli*: Suspended in isotonic sodium chloride dilution 1:100, was irradiated and 1cc from dilutions were plated on eosin-methylene blue agar. Counts were made after 48 hours incubation at 37°C. The average number of bacteria per cubic centimeter were found to be 5,800,000 before irradiation and 84,000 after irradiation.

One cubic centimeter of two 24-hour broth cultures of *E. coli* was added to 99 cc of whole human blood. After thorough mixing, the inoculated blood was passed through the irradiating chamber at the rate of 10 cc per 22 seconds. The average number of bacteria per cubic centimeter were found to be 14,000,000 before irradiation and 13,600,000 after irradiation. The irradiation made practically no reduction in the number of bacteria in the blood.

B—Irradiation of *Staphylococcus Aureus*: The procedure was similar to "A". The control samples in isotonic chloride solution showed reduction by the irradiation from 15,000,000 per cubic centimeter to 3,700 per cubic centimeter.

The specimens in whole blood showed absolutely no reduction in the bacterial count as a result of the irradiation.

C—Irradiation of *B. Mycoides*: The con-

trol samples in isotonic solution showed reduction from 180,000 per cubic centimeter to 800 per cubic centimeter. When whole blood was inoculated and irradiated, no reduction in bacterial content resulted.

It is concluded that when the microorganisms are suspended in isotonic saline solution and are exposed to ultraviolet radiations in the Knott Hemo-irradiator, a marked reduction in the numbers of bacteria occurs, but, however, when these same types of bacteria are suspended in whole human blood and irradiated, there is no reduction in the number of viable organisms. These observations are in agreement with Blundell and co-workers (*J. Bact.* 47 85 (1944)). The hemoirradiator cannot be effective by direct bactericidal action.

The Effect of Ultraviolet Irradiation upon the Toxin of *Clostridium Botulinum*: Miley had described the treatment of a patient with suspected botulism, using the hemo-irradiation technic and claimed apparently beneficial results. This toxin is known to be destroyed by direct irradiation so no further tests were made of this. Instead, they proceeded directly to experiment *in vivo*. The toxin was tested in mice. The toxin was introduced by absorption from the peritoneal cavity, which method is rapid and complete. One-half hour after injection, 2 to 3 cc of blood per pound were removed by cardiac puncture, oxalated and immediately passed through the irradiator at a speed of 10 cc per 22 seconds. The irradiated blood plus sufficient isotonic sodium chloride solution to wash the irradiation chamber was reinjected into the animal via the marginal ear vein. Two control groups of animals were studied. In one group the blood was irradiated but no toxin was administered so that any favorable or unfavorable result of irradiation alone could be noted. The other control group received the toxin but no irradiation. The treatment group received both toxin and irradiation.

The results of the tests indicated that blood irradiation of mice which did not receive the toxin had no observable harmful effect on the animals. There was no significant difference between the two groups which received toxin. The hemoirradiation had no effect upon the course of their illness as to either the total number of animals surviving or the number of hours of survival. These results are in agreement with those of Blundell and his associates dealing with staphylococcic scarletinal, diphtherial and tetanal toxins.

There is without question a contradiction between the laboratory evidence and the clinical reports accumulated in the studies of ultraviolet irradiation of the blood. In order to compare the two, it is necessary to evaluate the scientific accuracy of each. In the laboratory every effort is made to establish controls; in clinical studies controls are not always adhered to. If the therapy of a disease is to be evaluated clinically, both treated and untreated groups must be compared. The use of alternate or simultaneous cases is required under identical conditions of supplementary therapy.

If the clinical evidence offered in support of hemoirradiation therapy is examined, this same lack of acceptable experimental technic is found. There is a clinically diagnosed case of botulism apparently cured by hemoirradiation. The diagnosis was not verified by the finding of the botulinus toxin in the suspected food, and cure can be claimed only when the diagnosis has been verified. Other cases may be cited, and lead to the conclusion that "The variety of cases studied is good, but the number is insufficient and controls are lacking." The laboratory evidence against hemoirradiation indicates that further clinical work should be restricted to controlled observations on an experimental basis. The use of hemoirradiation on patients tends to displace methods of more proved efficacy and should be discontinued excepting for such controlled studies.

The increased oxygen capacity of the blood claimed by some to follow hemoirradiation, and reports of secondary emanations lack confirmation. The introduction of such emanations should await more definite evidence of their existence; even, if present, they are not necessarily significant.

ULTRAVIOLET BLOOD IRRADIATION THERAPY IN ACUTE VIRUS AND VIRUS-LIKE INFECTIONS

By GEORGE P. MILEY, M.D., D.Sc., MED. and JENS CHRISTENSEN, M.D., New York, N. Y.

From: The Review of Gastroenterology, Volume 15 No. 4 April, 1948

Inasmuch as at present there is no effective method of controlling serious virus or virus-like infections, any method which has shown even a preliminary encouraging trend in this direction must be considered. Ultraviolet blood irradiation therapy has, in our experience, shown such a trend in the 79 consecutive cases in which we have used the method.

The technic of ultra violet blood irradiation therapy consists of withdrawing approximately 3 per cent of patient's total blood volume, (e.g. 250 cc. from a 167 pound patient), citrating the withdrawn blood and immediately passing the citrated blood through a Knott hemoirradiator, a precision machine which exposes the blood safely and efficiently to high intensity ultra-

violet rays. The irradiated blood is then returned to the patient's venous circulation through closed rubber tubing attached to the needle through which the blood was originally withdrawn. The procedure takes about 15 to 20 minutes. Its excellent results in the treatment of acute pyogenic infections have been described in detail in original reports by Knott & Hancock, Rebbeck, Barret, Olney, and Miley. These favorable clinical results obtained have been shown to be due to a tremendous and rapid rise in the patient's own resistance to infection rather than to any direct bactericidal effect, though ultraviolet rays are lethal to all the common coccal bacteria. This is not surprising as only 3 per cent of the total blood volume is exposed to ultraviolet light during a blood irradiation. Furthermore, the amount of ultraviolet irradiation given is not sufficient to directly kill bacteria in septicemic blood in vitro, although the patients whose septicemic blood was so tested recovered with a rapid disappearance of bacteria from the blood stream, following ultraviolet blood irradiation.

This rapid rise in resistance to bacterial infection, plus the remarkable safety of the method, naturally suggested the use of blood irradiation in virus and virus-like diseases. The results in these disease processes have, to date, been extremely encouraging, in so far as can be judged by careful clinical observation in the cases studied. The difficulties of evaluating the results of any therapy in cases of acute poliomyelitis and primary atypical or "virus" pneumonia are fully recognized and appreciated, but fatalities do occur in these somewhat self-limited diseases and we feel that such fatalities can be to a great extent prevented by the use of ultraviolet blood irradiation therapy.

Tabular Report

We have classified, to the best of our ability, these cases of virus or virus-like infection as early, moderately advanced, and

apparently moribund, as we feel that the results of any therapy must be reported in cases differentiated as to the severity and progress of the acute infectious process at the time treatment was instituted.

The following consecutive cases were studied:

studied:	No. of	
Early	Cases	Recorded
Primary atypical or "Virus" pneumonia.....	2	2
Poliomyelitis		
Bulbo spinal type	0	0
Spinal type	36	36
Herpes		
Simplex	1	1
Zoster	3	3
Ophthalmicus	1	1
	43	43

Moderately Advanced

Primary atypical or "Virus" pneumonia	11	11
Poliomyelitis (non-toxic)		
Bulbo spinal type	4	4
Spinal type (ascending)	11	11
Mumps	1	1
	27	27

Apparently Moribund

Primary atypical or "Virus" pneumonia	2	2
Poliomyelitis		
Bulbo spinal type	7	6
	9	8

The single case of mumps reported is of interest, because on admission of this individual during a fulminating onset, extremely toxic symptoms were present, and within twelve hours after the immediate use of ultraviolet blood irradiation therapy, the whole clinical picture had changed completely, with a complete subsidence of toxic symptoms; in forty-eight hours parotid swelling had measurably diminished; recovery was complete in four to five days.

The early and moderately advanced cases are presented chiefly to show that ultraviolet blood irradiation therapy can do no harm, but may possibly prevent the disease process from progressing from either of these stages to a more serious one. In only one instance did a patient become worse after blood irradiation; one of the nine apparently moribund patients died.

The results in the use of ultraviolet blood irradiation therapy in five cases of early herpes were most gratifying as marked relief was obtained in all within forty-eight to seventy-two hours after blood irradiation. (In two old long standing cases of herpes zoster, recovery occurred slowly, but could not necessarily be attributed to the influence of blood irradiation.)

The poliomyelitis patients were consecutively treated in an epidemic in which the mortality of the untreated acute bulbar cases exceeded 40 per cent, as opposed to that of 9 per cent in the cases above. A rapid subsidence of toxic symptoms in such cases was observed to occur consistently.

Clinical Observations

1. Acute Poliomyelitis:

Group I; Bulbospinal Type

A. Severe toxic type:

In this group 6 of 7 patients critically ill with bulbospinal poliomyelitis recovered, one died.

In three of these cases the swallowing reflex, which had disappeared, reappeared within 24 hours following blood irradiation. In one of these 3, swallowing reflex disappeared again sixteen days later but once again returned to normal 24 hours after blood irradiation.

A rapid subsidence of toxic symptoms was noticed in the 6 cases which recovered.

In 2 additional cases of this type, consent for ultraviolet blood irradiation therapy was refused and each patient died.

One of these respirator patients was in the seventh month of pregnancy, received several blood irradiations and delivered a normal infant at term, the first successful delivery of this type to occur in California.

B. Mild non-toxic type:

These patients all recovered and in three of them, who were unable to swallow, normal swallowing reflex reappeared within 24 hours in 2 cases and within 48 hours in the third, following a single blood irradiation.

In both groups there was, following blood irradiation, a rapid disappearance of the symptoms of general apathy, anorexia, cachexia pallor and extreme fatigue as well as cyanosis when present.

Group 2; Spinal Type

A. Extremely toxic type, with apparent progression of muscle weakness and spasm:

In this group of dangerously ill poliomyelitis patients, the disease process which manifested itself by the rapid progression of muscular weakness and spasm, usually of the ascending type, would normally be expected to develop into the severe toxic type of acute bulbar poliomyelitis described above. However, it was very definitely noted that as soon as blood irradiation was instituted the progression of muscle weakness and spasm ceased, so that in none of the 6 individuals was there any need for a respirator, though several had beginning signs of respiratory embar-

rassment when ultraviolet blood irradiation therapy was first employed.

In all 6, a rapid subsidence of toxic symptoms occurred in 48 to 72 hours.

- B. Toxic type, but no apparent progression of muscle weakness and spasm:

In this group of 5 patients a rapid subsidence of toxic symptoms occurred in 48 to 72 hours and all recovered uneventfully.

- C. Mild type, with few or no toxic symptoms:

In this group there were 36 individuals whose acute symptoms had subsided before treatment was instituted. It was not possible to state the final effects on these patients, so that no significant observation as to the influence of blood irradiation could be made, though it may be stated with a great degree of certainty that no ill effects were noted.

2. Primary Atypical or "Virus" Pneumonia

—It is our personal opinion that primary atypical pneumonia can be easily and efficiently controlled by ultraviolet blood irradiation therapy.

A rapid subsidence of toxic symptoms occurs, a quick clearing of x-ray evidence of pathology has been noted consistently and we feel hospitalization and convalescence is greatly shortened by this method and this type of pathology. The one symptom which may persist for two or three weeks is a dry cough which is of little importance as it disappears with a minimum of inconvenience. The sedimentation rate falls as the patient im-

proves clinically, but in some cases remains high for some weeks after all clinical and x-ray has returned to normal.

If a patient with this type of pneumonia is seen in the first days of the disease and is given ultraviolet blood irradiation therapy he or she will usually recover within five to seven days, although in 2 of the 17 patients x-ray evidence of complete clearing of the pulmonary field did not occur until three weeks had passed.

3. Herpes:—A marked amelioration of the symptoms of acute herpes was observed to occur within 24 to 48 hours following the uses of ultra-violet blood irradiation in all five cases. (This does not occur in chronic herpetiform lesions in which relief occurs so slowly that it is impossible to tell whether or not spontaneous regression has occurred or whether blood irradiation has had any effects).

Summary

1. Results of the use of ultraviolet blood irradiation therapy in 79 consecutive cases of acute virus or virus-like infections have been described and certain definite clinical observations have been made from the study of these cases.
2. Rapid recovery occurred in 100 per cent of the 43 early cases; recovery occurred in 100 per cent of the 27 moderately advanced cases, and in 8 of 9 of the apparently moribund ones 88.8 per cent.
3. Clinical observations made strongly suggest that ultraviolet blood irradiation may be found to be the ideal method of controlling acute virus or virus-like infections safely and efficiently.

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